

## Cosmic Chemistry: Planetary Diversity

## Ouch! That Hurts!

### STUDENT ACTIVITY—PARTS 1 AND 2

#### PART 1

##### Instructions:

- The team leader should appoint one member of the team to obtain the following materials and equipment for the team.
  - Projectiles: a steel ball, a small stone, and a piece of ice
  - Metal pans or trays filled with at least a 4-5 cm layer of materials such as gelatin, cornstarch, sand, clay, or pumice as provided by your instructor
  - Container of water
  - Metric ruler
- As a team, decide how you should set up the equipment so that you can observe what happens when each of the projectiles impacts on the surface of the samples provided by your instructor. Have your method approved by the instructor before you start.
- List all variables to be tested and controlled during each test. Think about how to control velocity.
- Write two research questions based on the variables that are to be tested. Make predictions of how different projectiles would affect craters and how different angles would affect craters. Students may use pictures.
- Drop the steel ball, the stone, and the piece of ice, one at a time, vertically onto each surface from the same height. (That is, the projectile should impact the surface at a 90° angle.)
  - Observe the surface for a few minutes following each impact.
  - Make drawings of the impact zone and describe in writing what happened immediately after the impact.
- Smooth the surface of the materials in the pans before proceeding.
- Launch each of the projectiles, one at a time, at an angle that is close to 45° to the surfaces.
  - Observe the surface for a few minutes following each impact.
  - Make drawings of the impact zone and describe in writing what happened immediately after the impact.
- Write a paragraph that compares and contrasts the impact zones made by each of the projectiles when they collided with the same surfaces at different angles.
- Read Student Text ["Ouch that Hurts!"](#)



#### PART 2

##### Instructions:

Use the information given in the Student Text "Ouch! That Hurts!" to answer the questions below.

- A stony meteoroid having a diameter of 4000 m is traveling at a velocity of 7.5 m/sec. Could this meteoroid possibly impact:
  - Venus?
  - Earth?
  - Mars?
 Explain the reason for your answer for each planet.

11. Would you predict that the meteoroid described in 10 above would remain intact or fragment before impact? Explain your answer.
12. Could an iron meteoroid with a diameter of 1500 m traveling at 11 km/sec be expected to reach the surface of the Earth?
13. An icy meteoroid that is 100 m in diameter has penetrated the planet's atmosphere and is accelerating at a rate of  $10 \text{ m/sec}^2$ . Could this meteoroid possibly impact:
  - a) Venus?
  - b) Earth?
  - c) Mars?
 Explain the reason for your answer for each planet.
14. We have visible images of the impact cratering on, Mercury, Mars and the Earth. Would you predict that Venus would have more, fewer, or about the same number of impact craters as:
  - a) Mercury?
  - b) Mars?
  - c) The Earth?
 Explain the reason for your answer for each planet.
15. If the same size and type of meteoroid impacted the surface of Venus, Earth and Mars, which planet's atmosphere would be the most affected by the vapor and ejecta from the impact?
16. Would you predict that the entry of meteoroids into the atmospheres of the giant planets would be more difficult, less difficult, or about the same in difficulty as their entry into the atmospheres of the terrestrial planets? Explain your prediction.

